Probenergy
REDEFINING ENERGY STORAGE

280 Liquid Cooling Container Project Specification

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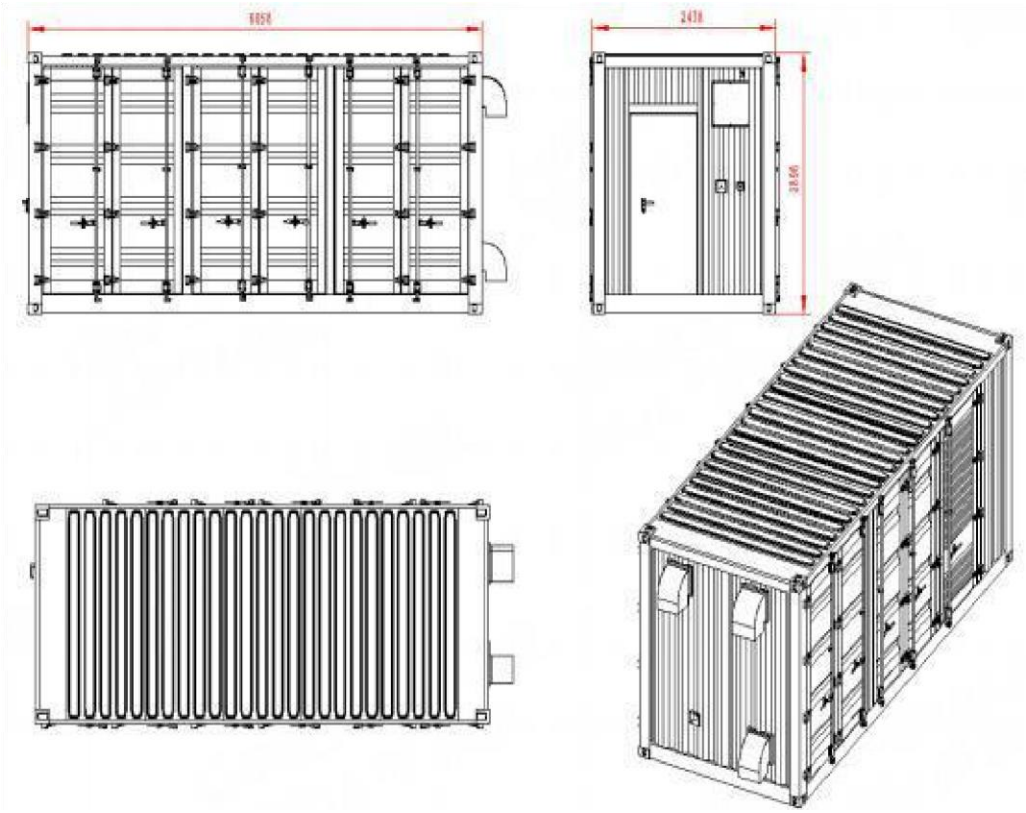
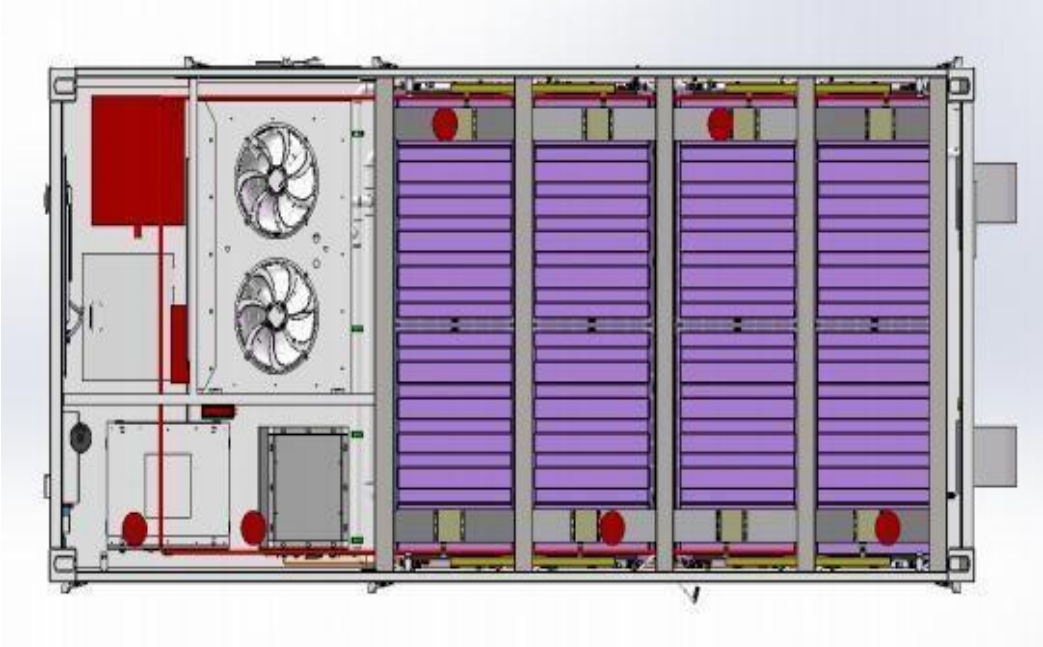
CONTENT

1. Product introduction

1. 1 Introduction This project is a 1.5MW/3.35MWh energy storage system with non-walk-in design. The system includes PACK warehouse, electrical warehouse, liquid cooling unit warehouse, safety fire warehouse, etc., which is convenient for equipment installation and meets the requirements of safe and reliable long-term operation of the entire system. Requirements, it can be applied to application scenarios such as peak-shaving and valley-filling, peak-shaving and frequency modulation on the power generation side, grid side, and user side for 2 hours or more, demand-side response, and renewable energy grid integration.





The layout of the container is shown in the figure above, and the weather-resistant steel profile tailor-welded box scheme is adopted. The main material of the box is SPA-H.Dimension 6058*2438*2896.

The container energy storage power station should include energy storage battery units, BMS battery management system, fire protection system, thermal management system, confluence power distribution system, ventilation system, video surveillance, etc. The equipment is integrated in the 20-foot battery prefabricated cabin. The standard unit of the battery prefabricated cabin has its own independent power supply system, temperature control system, heat insulation system, flame retardant system, fire alarm system, electrical interlocking system, mechanical interlocking system, safety escape system, Automatic control and safety guarantee systems such as emergency systems and fire protection systems.

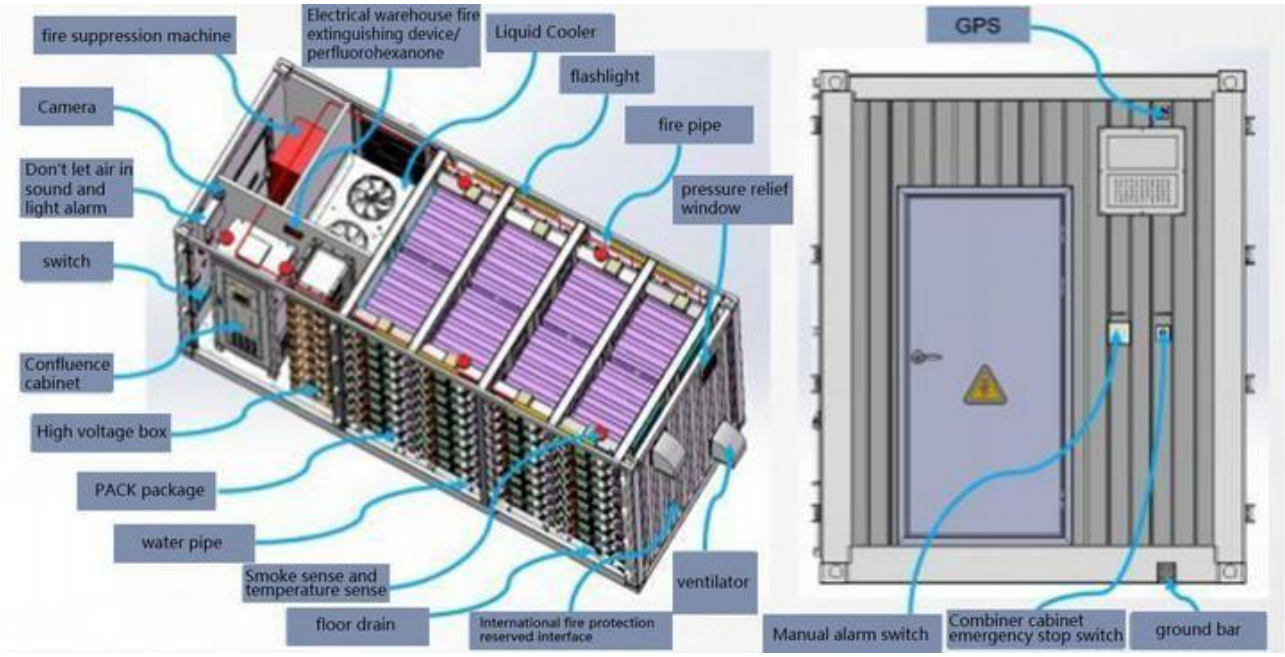


Figure 2 Distribution map of each equipment in the container

Each container is equipped with 9 battery clusters, and the installation method of the battery clusters is shown in Figure 3 below. Each battery cluster is composed of 1 high-voltage box, 8 PACK boxes, BMS, inter-box collection, power wiring harness, etc., and is arranged horizontally on the container mounting frame. The high-voltage box is equipped with a battery cluster management unit, which is used for pre-charging contactor control, main circuit contactor control, cluster current collection, cluster temperature and monomer voltage status report to the master control, and performs protection and alarm according to the set protection threshold. The function communicates with the master controller of the battery system through the CAN bus.

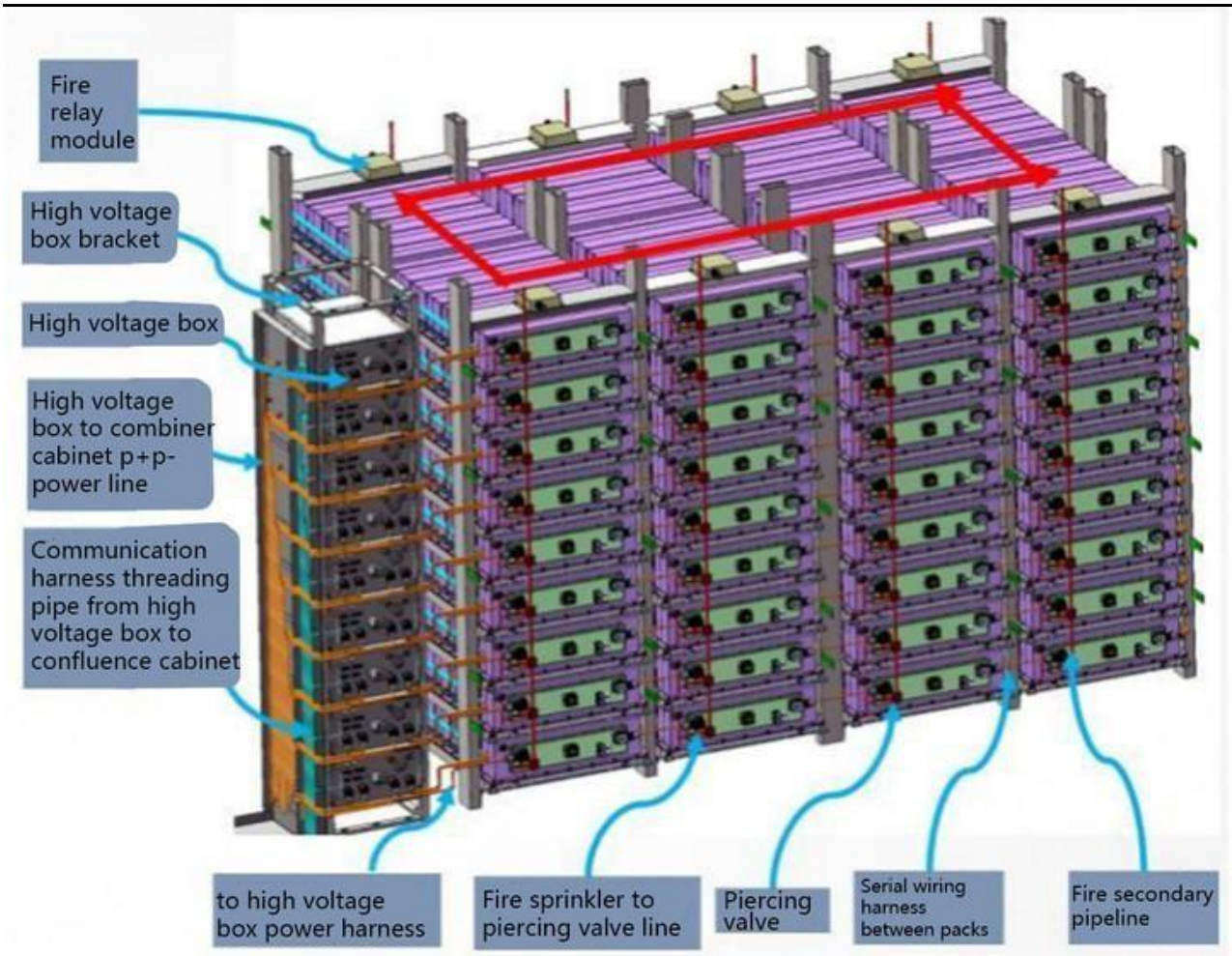


Figure 3 Container Installation Structural Diagram

1.2 Design standards

Container design should comply with but not limited to the following standards:

➤ GB 4208-2017	Enclosure rating (IP code)
➤ GB/T 5226. 1-2019	Electrical safety of machinery - Electrical equipment for machinery - Part 1: General specifications
➤ GB/T 2900.33-2004	Electrotechnical Terminology Power Electronics Technology
➤ GB/T 191-2008	Packaging, storage and transportation icons
➤ GB/T 1413-2008	Series 1 Container Classification, Dimensions and Rated Mass

➢ GB/T 1835-2006	Series 1 Container Corner Fittings
➢ GB/T 4171-2008	Weathering structural steel
➢ ISO12944	Paints and varnishes - Corrosion protection of steel structures by protective paint systems
➢ GB 50116-2013	Code for design of automatic fire alarm system
➢ GB 51048-2014	Code for Design of Electrochemical Energy Storage Power Station
➢ GB 17467-2010	High voltage/low voltage prefabricated substation
➢ GB/T 20138-2006	Degree of protection of electrical equipment enclosures against external mechanical impacts
➢ GB 50217-2007	Specifications for Design of Electric Power Engineering Cables
➢ GB50168-2006	Cable line construction and acceptance specification
➢ GB/T 23932-2009	Metal face insulation sandwich panel for building
➢ GB/T 9978-2008	Test method for fire resistance of building components
➢ GB/T 7392- 1998	Technical requirements and test methods for containers
	《Electrical Design Manual of Electric Power Engineering - Second Part》
	《Twenty-five Key Requirements for Preventing Major Accidents in Electric Power Production》

1.3 Technical parameters

The technical parameters of the container are shown in the table below:

Container technical parameter table

	Item	Technical parameter
1	model	LFP- 1331.2V-3354.6KWh

2	System Configuration	1P416S*9clusters
3	Cell capacity	280Ah
4	Combination	9P416S+9 high voltage boxes + 1 combiner cabinet
5	magnification	0.5P
6	Rated Capacity	2520Ah
7	nominal voltage	1331.2V
8	rated power	1.72MW
9	Nominal energy	3.35MWh
10	Dischargeable energy	3.35MWh
11	Dimension	L6058*W2438*H2896
12	Weight	32T
13	Integration requirements	PACK is directly installed to meet the overall transportation
14	Fire Fighting System	PACK Class Gas/Water Fire Protection
15	thermal management system	The ambient temperature is controlled at 25±5°C, and the battery runs at the highest temperature Temperature≤3℃, temperature difference≤5℃
16	Battery temperature control method	Forced liquid cooling
17	BMS system	3-layer architecture, satisfying system control and passive balance
18	power requirements	The standby consumption requirement is ≤300W, and the working energy consumption is ≤80kWh/ 1 cycle per day

19	Operating temperature range	-30~50℃
20	Storage temperature range	-30~55℃
21	Maximum working altitude	≤4000m

1.4 The overall technical requirements of the container body

✓The container is sprayed with text, color, and graphic decoration, which are determined according to customer needs.

✓The steel structure of the container adopts SPA-H weather-resistant steel plate, and the flat roof structure is convenient for stacking.

✓The container shell meets three layers of protection: the primer is zinc-rich paint, the middle paint is epoxy paint, the outer paint is acrylic paint, and the bottom frame is made of asphalt paint.

✓The container wall panels and hatches are treated with heat insulation measures. Under the environmental conditions of the temperature difference between the inside and outside of the cabin is 55°C, the heat transfer coefficient is less than or equal to 1.5W/(m2 °C)

The thickness of the insulation material meets the following requirements:

Side wall, partition wall: rock wool, thickness 50mm;
PACK warehouse door: rock wool, thickness 50m;
Bottom plate, top: rock wool, thickness 50mm.

✓The internal paint shall be zinc-rich primer (thickness 25μm) + epoxy resin paint (thickness 50μm), the total paint film thickness shall not be less than 75μm.

✓The exterior paint shall be zinc-rich primer (thickness 30μm) + epoxy resin paint (thickness 40μm) + chlorinated plasticized rubber or acrylic topcoat (thickness 40μm), the total paint film thickness shall not be less than 110μm.

Substrate	Variety	Name	Number of construction roads	Dry Film Thickness (microns)
Metal structure	Primer	HAZ01 epoxy zinc-rich primer (high zinc)	2	80
	Intermediate paint	HA01 epoxy mica iron intermediate paint	3	120
	Top finish	SB02 Aliphatic polyurethane anti-corrosion topcoat	3	100

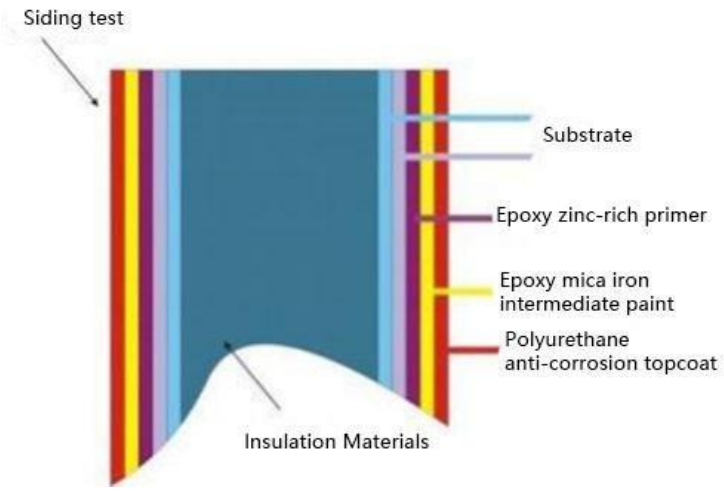


Figure 4 Container Anti-corrosion Measures Diagram

- Floor load
  - The bottom plate bears the following static loads without plastic deformation or damage:
  - Load bearing at the bottom of the battery rack：＞3500kg/m2 ；
  - Load bearing at the bottom of the combiner cabinet：＞ 1000kg/m2 ；
  - The remaining：＞1000kg/m2。
- Roof load
  - The roof is subjected to the following static loads without plastic deformation or damage
  - concentrated load ：3kN/0. 18m2；(600mm*300mm area)
- Thermal insulation: container wall panels and hatches are treated with heat insulation measures, and a temperature regulation system is adopted to control the internal temperature of the container at 5°C±5°C~30±5°C
- Anti-corrosion: The overall structural frame of the container is made of high-quality steel. In the actual operating environment, the actual effective service life of the container is no less than 20 years (only refers to the overall structure of the container).
- Fire resistance: the container shell structure, heat insulation materials, interior and exterior decoration materials, etc. are all flame retardant materials.
- Shockproof: Before the container leaves the factory, it will be tested for hoisting, load-bearing,
- and sports car, which can ensure that the mechanical strength of the container and its internal equipment meets the requirements under transportation and earthquake conditions, and there will be no failures such as deformation, abnormal function, and non-operation after vibration
- Battery containers are fitted with lighting fixtures and emergency lighting fixtures. The lighting fixtures are explosion-proof, and the lighting lines are made of dark cloth through pipes. The lighting switch and distribution box are installed in the battery container.
- The battery container has ventilation. The exhaust device and the air inlet can close the air duct to save energy and maintain the indoor temperature when the air is not exhausted.
- The door of the battery container opens outwards, and a non-combustible or difficult-to combustible solid door is used.
- The battery container is equipped with fire extinguishers, fire alarm bells, temperature detectors, and smoke detectors. The battery container box needs to be grounded, and the foundation needs to be grounded.

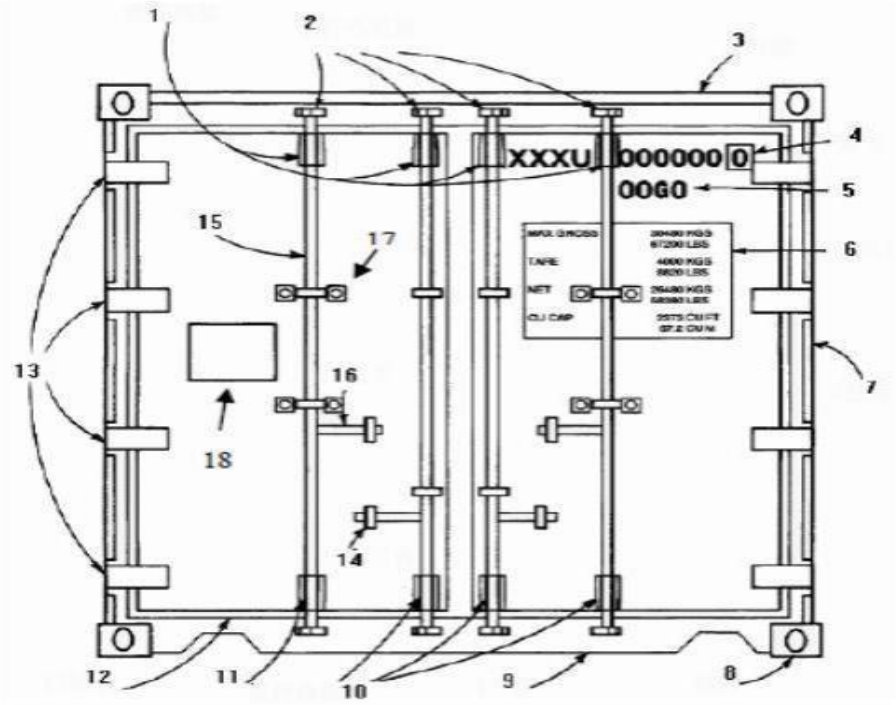
1.4. 1 **Container size**

Table 2 Dimensions and Specifications of Containers (High Cabinets)

Name	Item	Length(mm)	Width(mm)	Height(mm)	N.W (kg)
10ft container	External dimensions	3004	2438	2896	1750
	Internal dimensions	2840	2352	2690	
20ft container	External dimensions	6058	2438	2896	3480
	Internal dimensions	5898	2352	2690	
30ft container	External dimensions	9274	2438	2896	4100
	Internal dimensions	9114	2352	2690	
40ft container	External dimensions	12192	2438	2896	4700
	Internal dimensions	12031	2352	2690	
45ft container	External dimensions	13716	2438	2896	5700
	Internal dimensions	13556	2352	2690	

1.4.2 **The structure of the container box**

1.4.2.1 Structural composition diagram of container door



1. Locking Bar Bracket
2. Locking Bar Cam
3. Door Header
4. Owner's prefix and serial number
5. Size and Type Code
6. Weight Panel
7. J-Bar
8. Corner Fitting & Corner Casting
9. Door sill
10. Locking Bar Bracket
11. Locking Bar Bracket
12. Door Gasket & Door Seal
13. Hinge
14. Door Handle Retainer
15. Locking Bar
16. Door Handle
17. Locking Var Guide
18. Consolidated data plate

1.4.2.2 Container mechanical interface characteristics

The container meets the basic installation requirements for crane installation, and provides two fixing methods: bolt and welding. The bolt fixing points and welding points are reliably connected with the non-functional conductive conductors of the entire container (container metal shell, etc.),

and at the same time, provide users with at least two grounding points in the form of copper bars that meet the requirements of the most stringent electrical standards.

A sufficient area for construction and maintenance manholes is reserved inside the container to ensure that construction and operation and maintenance personnel can work in the lower part of the container. The exact location and size of the construction and maintenance wells in the container are clearly marked in the drawing documents.

The protection level of the energy storage container is not lower than IP55, the anti-corrosion level requirement is C5, and complies with the relevant provisions of IEC 60529.

1.4.2.3 Grounding design

The container provides grounding copper bars. The grounding copper bar can be reliably communicated with the non-functional conductive conductor of the entire container (the metal shell of the container that is not charged under normal circumstances, etc.). At the same time, the container provides users with 4 grounding points in the form of copper bars. A reliable equipotential bonding must be established with the non-functional conducting conductors of the entire container, the grounding point being at

The diagonal position of the container. Grounding point for non-functional conductive conductors.

The partial view of the grounding copper bar is shown in the figure below:

Figure 6 Partial view of grounding copper bar

1.4.2.4 **Lightning protection design**

The roof of the container is equipped with a reliable high-quality lightning protection system. The lightning protection system is connected to no less than two grounding copper bars provided by the container to the user through grounding flat steel or grounding round steel. The effective cross -sectional area of the conductor in the grounding system not less than 250mm2.

An anti-surge protection module is installed on the line. Surge protector, also called lightning protector, is an electronic device that provides safety protection for various electronic equipment, instruments, and communication lines. When a peak current or voltage suddenly occurs in the electrical circuit or communication line due to external interference, the surge protector can turn on the shunt in a very short time, thereby avoiding damage to other equipment in the circuit caused by the surge.

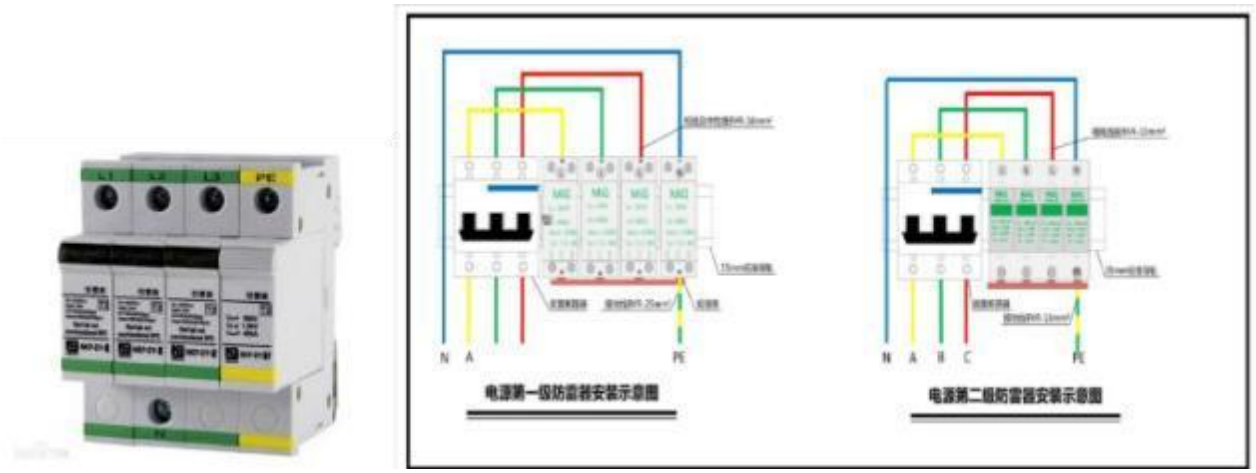


Figure 7 Schematic diagram of surge protector

2. Explosion diagram

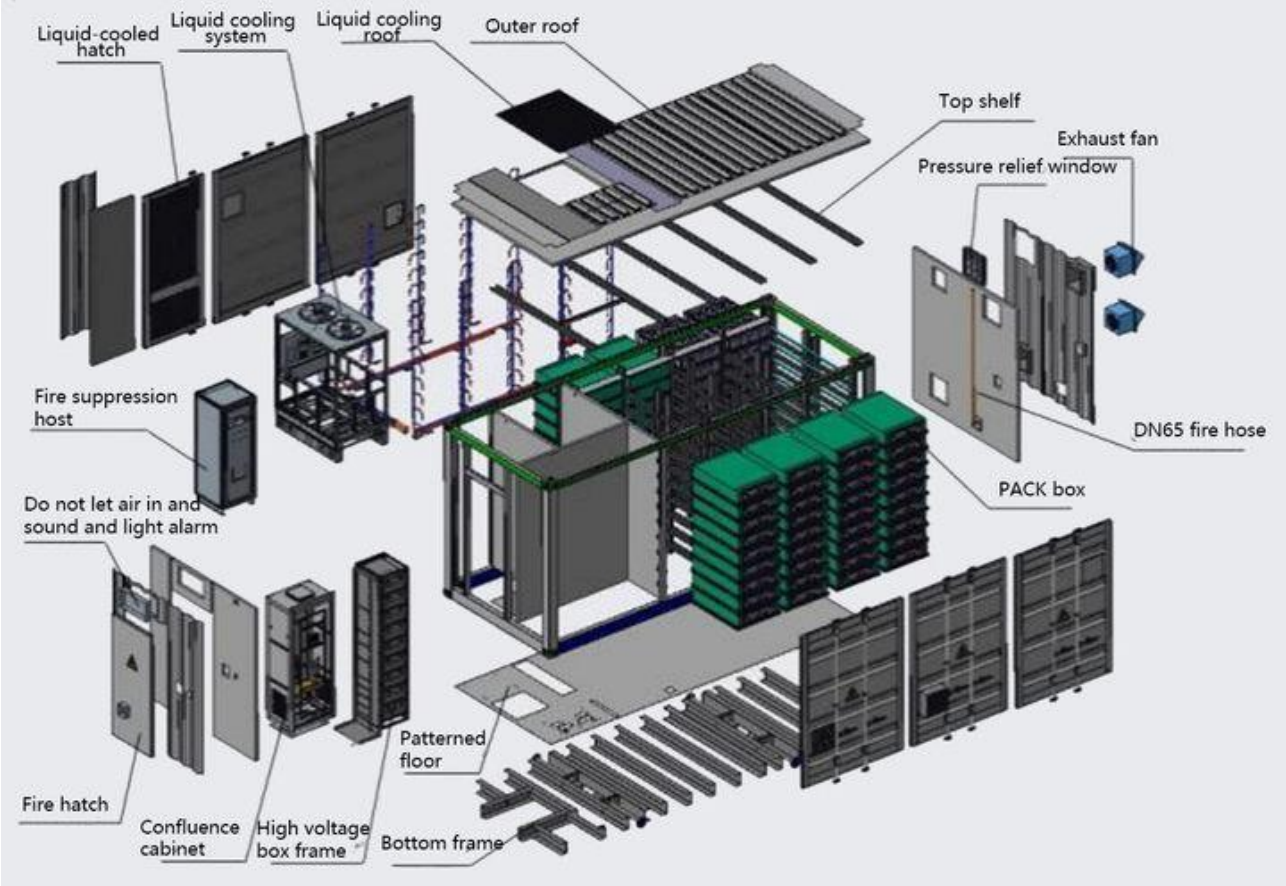


Figure 8 Exploded View of Container Layout

3. Electrical System Design

3. 1 High voltage box introduction

The high-voltage box assembly is mainly used to connect the input of the cluster-level power battery and output to the confluence cabinet assembly. It integrates molded case circuit breakers, DC contactors, fuses, AC/DC switching power supplies, pre-charging resistors, BMS hosts, High-voltage connectors and boxes, etc., constitute the high-voltage box control assembly.

The power level of the high-voltage box assembly reaches 1500V/250A, and the shape and installation hole size are W*H*D=481mm*230mm*580mm (Including mounting lugs), the distance between the centers of the mounting lugs is W*H=458mm*130mm.

Each battery cluster is equipped with a high-voltage box, which contains the battery cluster management unit and electrical components, which are used to manage and protect the operating status of the entire battery cluster.

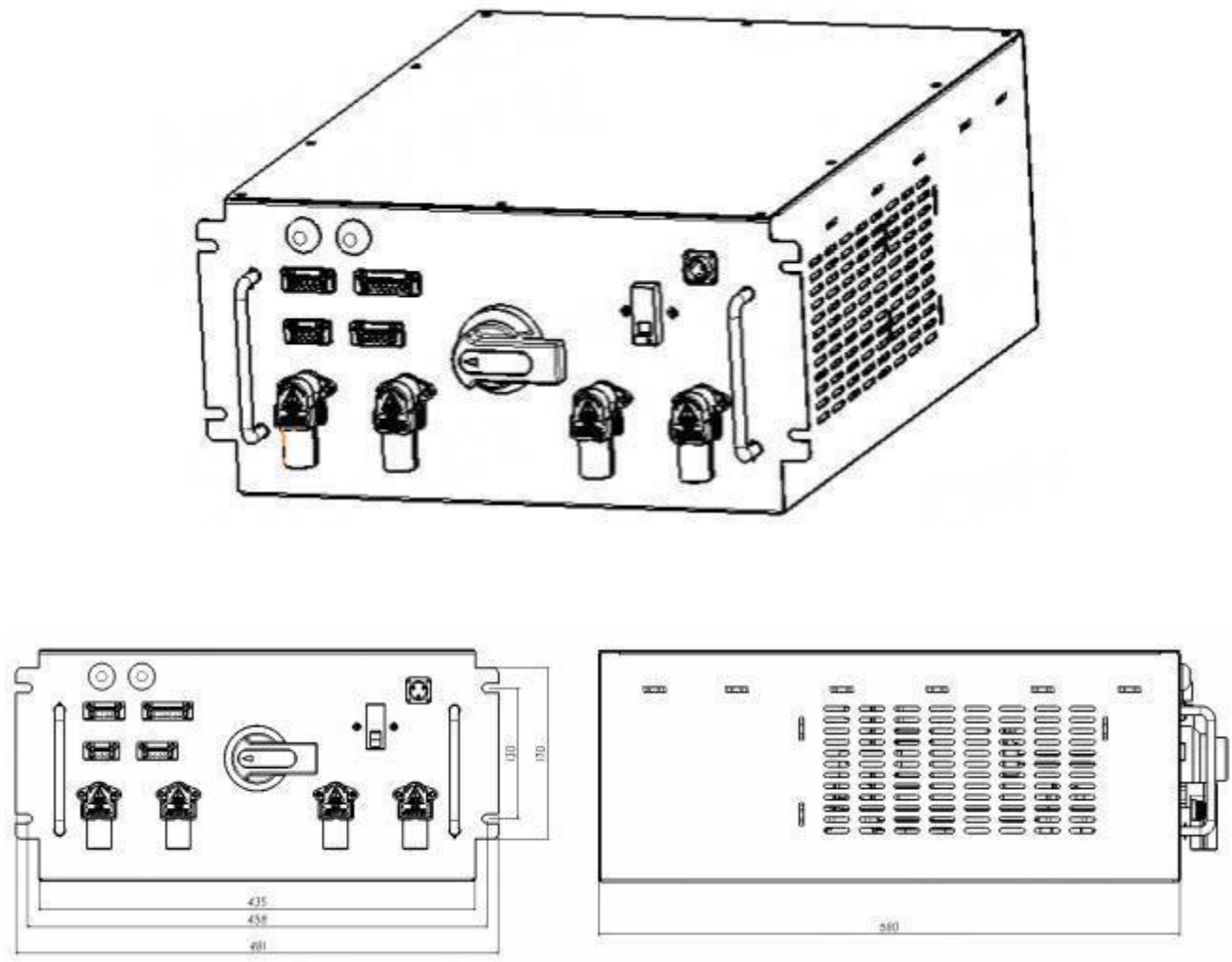


Figure 9: High voltage box shape and installation hole size diagram

3. 1. 1 **Front Panel Definitions**

NO	Port definition	Function instruction	Remark
1	B+	Battery cluster input positive terminal	Connect the positive terminal of the battery pack
2	B-	Battery cluster input negative terminal	Connect the negative terminal of the battery pack
3	P+	PCS input positive terminal	Connect PCS positive terminal
4	P-	PCS input negative terminal	Connect PCS negative terminal
5	AC input	BMS power supply	Connect to mains 220V
6	AC open Breaker	BMS power supply switch	Manual control on and off
7		battery cluster switch	Manual control on and off, can be equipped with manual operation, and can also be disconnected by shunt trip
8	Running lights	BMS operation instructions	Gree n
9	warning light	BMS alarm indication	Red
10	To SBMU	CAN communication, power supply and address assignment with SBMU slave	BMS communication
11	To SBAU	CAN communication with SBAU stack control	BMS communication
12	Debug interface	Used for program upgrade and PC test	

3. 1.2 Electrical Schematic

The main functions of the electrical components in the high-voltage box are as follows:

(1) Fuse: When the (overload or short circuit) current exceeds the specified value, the heat generated by itself will fuse the fuse, and can quickly act to disconnect the circuit within the specified time;

(2) Load switch: It has a simple arc extinguishing function and can disconnect the load current (it can be used to break and close the overload current that the load current is less than a certain multiple, usually 3-4 times), and cannot be disconnected or disconnected quickly Short-circuit current; it can form a clear breaking point, often used in conjunction with fuses for short-circuit protection.

(3) Circuit breaker: a mechanical device switch (which can break overload current, short circuit current leakage protection and other functions); it mainly relies on current transformers to cooperate with secondary equipment for protection;

(4) Contactor: a kind of "automatic switch" that uses a small current to control the operation of a large current, and forms a safety protection mechanism with other components in the circuit; (5) Pre-charge resistance: limit the current of the main circuit during the upper high voltage process;

(6) Pre-charge relay: control the opening and closing of the pre-charge circuit;

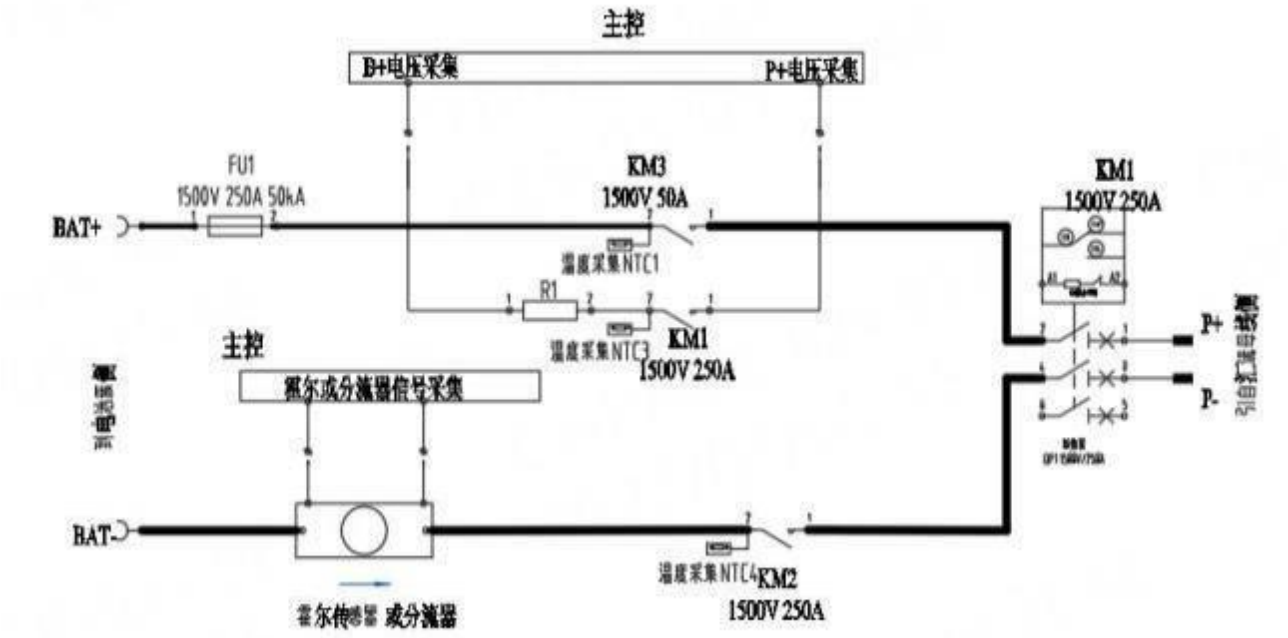


Figure 10 Electrical schematic diagram of high voltage box

3. 1.2 Topology

The topological diagram of the high-voltage box is divided into high-voltage and low-voltage parts, and the functions of each part are introduced as follows:

Charge and discharge circuit: equipped with main positive fuse and DC moulded case circuit breaker to realize discharge open circuit protection and maintenance isolation, and equipped with main positive and negative relays to realize main circuit discharge control.

Equalizing resistance circuit: both ends of the main positive relay are connected in parallel—a equalizing resistance circuit, equipped with a pre-charging relay and a pre-charging resistor, which can be incorporated into a balancing resistor when the battery clusters are unbalanced to achieve voltage balance.

AC power supply circuit: AC220V power supply output, which provides energy sources for the switching power supply for the back-end controller and the electric operation of the circuit breaker. AC/DC power supply circuit: After converting the AC power to 24V, it supplies power for all controllers at the back end and the sorting driven by the controller.

Alarm operation indicator light: Accurately predict the electrical operation status in the high-voltage box.

Communicate with the slave controller in the battery box in the cluster: Accurately grasp the battery information in the battery box.

Communication with the master controller: report the battery information in the cluster.

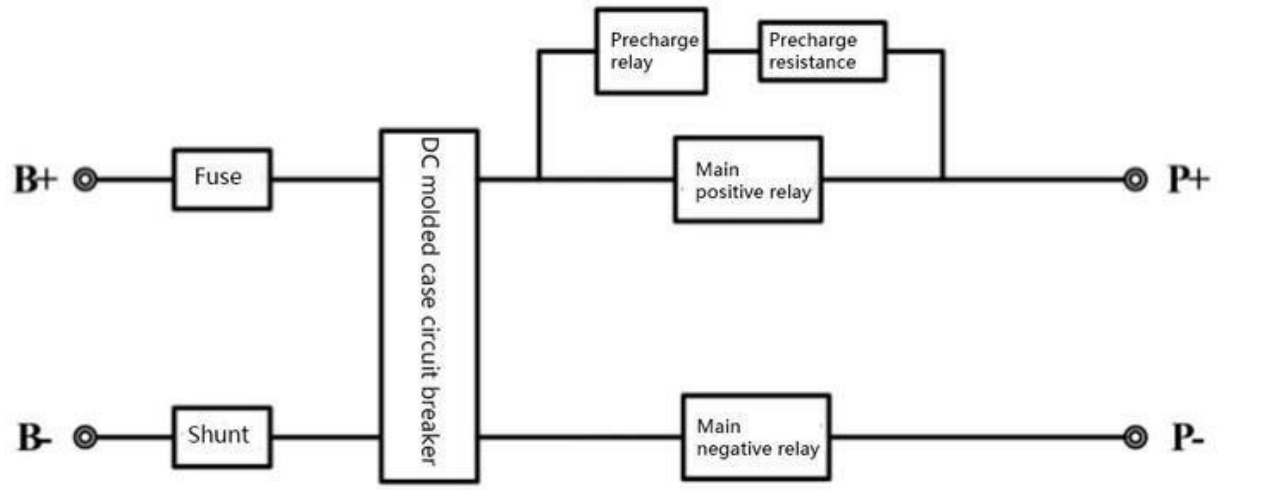
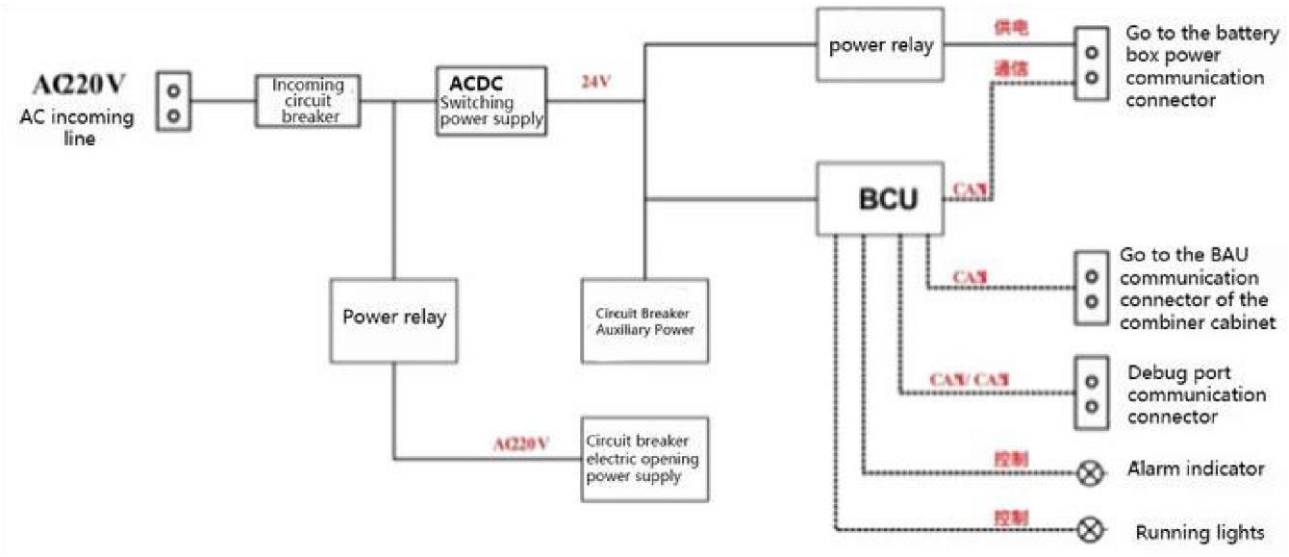


Figure 11 Topological diagram of the main circuit of the high voltage box



3 .2 **Introduction of confluence cabinet**

This combiner cabinet is used to manage the high-voltage input and output between the battery system and the PCS, and the power-on and power-off process of the energy storage DC side system.And high voltage protection logic.

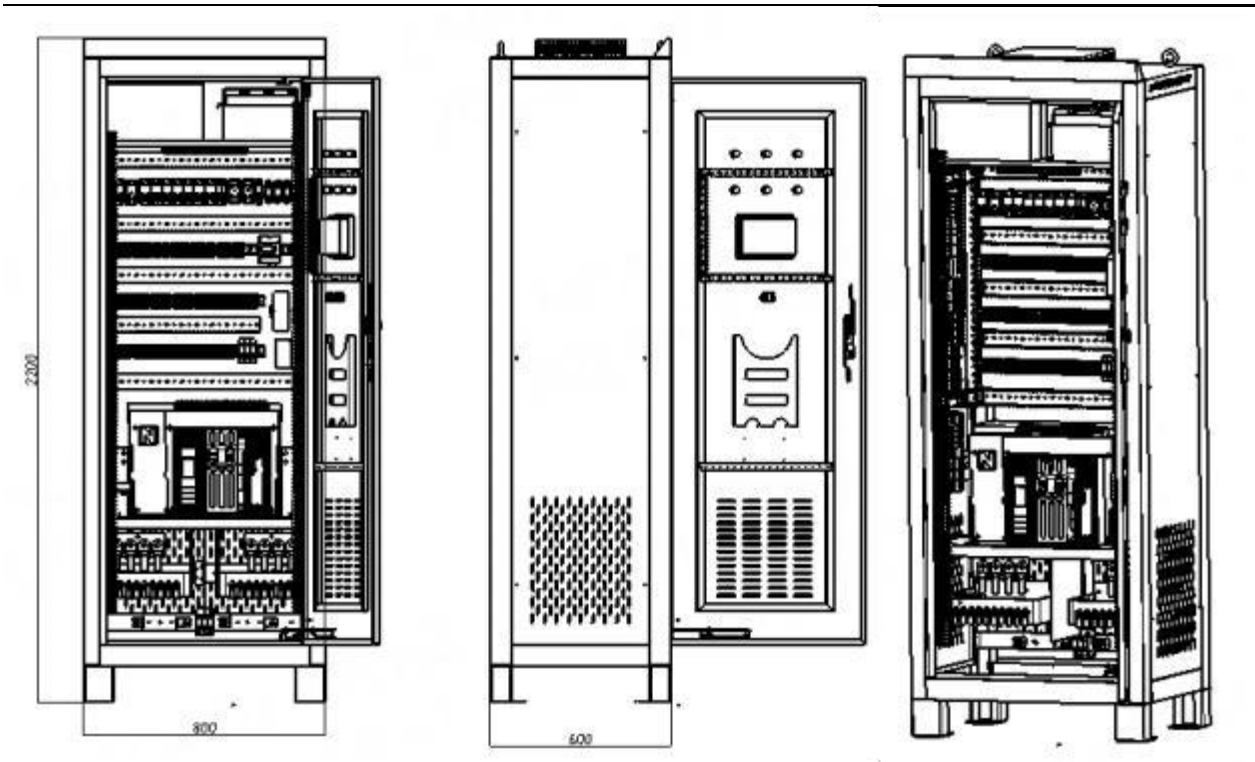


Figure 13 Dimensions of the combiner cabinet

3.2. 1 Functional description

Support 220VDC power input to supply power to the UPS inside the combiner cabinet;

The UPS supplies power to the switching power supply (220Vac), which is converted by the switching power supply and indirectly supplies power to the main control module (24Vdc is recommended);

Support power supply to the high voltage box, the power supply voltage is 220Vac, and indirectly supply power to the main control module;

Supports communication with PCS inverters, EMS systems, and dynamic ring detection equipment;

Support the opening and closing of the circuit breaker and status monitoring, and the status is displayed by the indicator light;

Summarize the real-time data information of the entire system, support battery stack status data processing, and realize management and control of battery charge and discharge after processing;

Support emergency stop control function, in case of emergency, press the emergency stop switch button outside the cabinet to stop the operation of the entire energy storage system;

Support the LED status indication of the combiner cabinet, including three status indicators of power supply, status and fault;

- The SCU main control module installed in the confluence cabinet has isolated LAN, CAN, RS485, RS232, TF card, USB interface, and realizes the connection with the RCU main control module, MM10 display and control module, PCS inverter, EMS system, and dynamic ring detection equipment. Communication, data storage and protection, and can realize internal data, operation data storage and power-off storage, support program upgrade and data export;
- The MM10 display and control module installed in the confluence cabinet has isolated LAN, micro USB, USB, TF card interfaces and a 10.1-inch display to realize communication with the SCU master control module and data display of the entire battery system;
- Equipped with battery (single, module, cluster, stack) overvoltage, undervoltage, differential pressure, overcurrent, undercurrent, overtemperature, low temperature, temperature difference, short circuit, insulation, relay diagnosis and other alarms and protections;

3.2.2 **Topology**

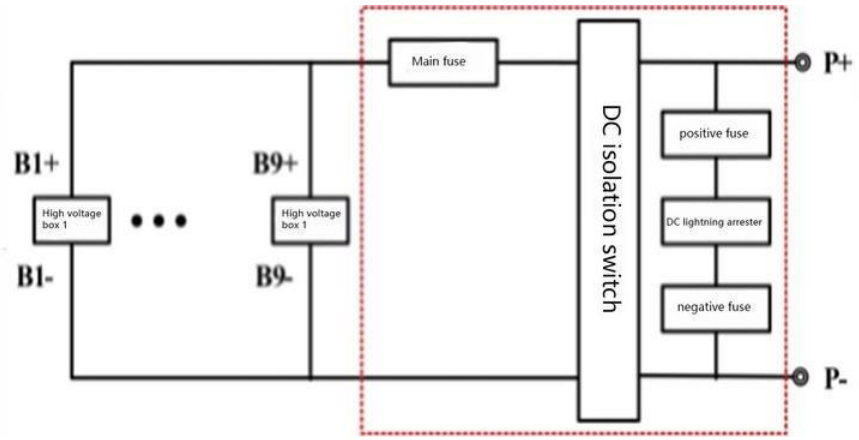


Figure 14 Topological diagram of high voltage in combiner cabine

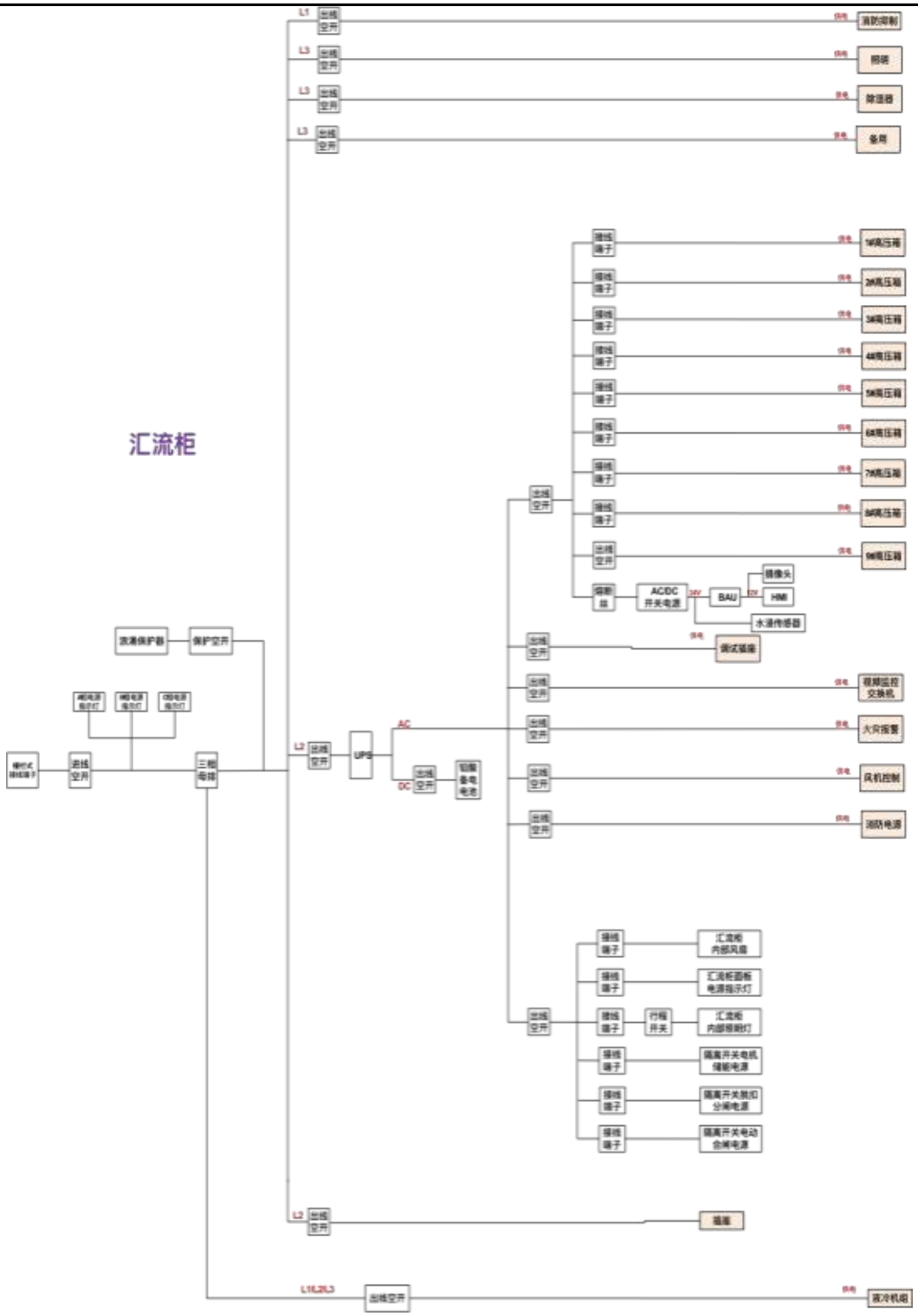


Figure15 Topological diagram of high voltage in combiner cabinet

The functions and functions of the main electrical components in the confluence cabinet are as follows:

(1) DC isolation switch: used in the main circuit to play the role of system-level DC on-off;

(2) Main positive fuse: cooperate with the main isolating switch to protect the circuit from short circuit;

(3) DC lightning protection device: protect DC lines and switches from lightning strikes;

(4) DC lightning protector protection fuse: protect the system when the lightning protector fails or short-circuits;

(5) Each AC branch circuit breaker: It plays the role of normal breaking, and plays a protective role in the event of a short circuit in the line;

(6) Switching power supply: used to supply power to controllers such as BMS;

(7) AC lightning protection device: protect DC lines and switches from lightning strikes;

(8) AC surge protector protection circuit breaker: protect the system when the surge protector fails or is short-circuited;

(9) Fan: used to dissipate heat from the combiner cabinet;

4. Thermal management

4. 1 Functional description

The environment and temperature of the battery system will directly affect its normal operation, including battery cycle life, output power, service capacity, safety and reliability, etc. Therefore, in order to obtain the best performance and life of the battery, it is necessary to control the temperature of the battery system within a specific range through thermal management, so as to reduce the uneven temperature distribution in the battery, so as to improve battery aging and eliminate potential risks.

4.2 Liquid cooling composition

The liquid-cooled thermal management system consists of a liquid-cooled plate, a liquid-cooled unit, liquid-cooled pipelines, high and low-voltage wiring harnesses, and coolant. Regarding the problem of liquid-cooled leakage, the following measures are taken. First, the liquid cooling joint adopts the vehicle-grade leakage-proof liquid cooling pipe push-in joint, which can ensure that the risk of liquid leakage is minimized when the energy storage system is running. Second, a liquid level sensor is installed in the expansion tank of the liquid cooling unit. If there is liquid leakage, the liquid cooling unit will alarm. Third, the protection level of the battery pack design is IP67, which ensures that the system will not be affected by liquid leakage. The liquid cooling plate of the battery pack is an aluminum profile (aluminum extrusion), which integrates the functions of the base and the liquid cooling plate. Among them, a gasket is installed between the liquid cooling plate and the sheet metal upper cover, which is sealed to IP67 by screw locking; at the same time, The liquid cold plate will also be tested for air tightness to ensure that the liquid cold plate has good sealing performance. The liquid cold plate of the battery pack adopts a "serpentine" flow channel, and the cooling liquid is 50% water + 50% ethylene glycol. The liquid cooling system adopts a certain heat management strategy, so that when the cooling liquid flows through the liquid cold plate, to cool or heat the battery pack.

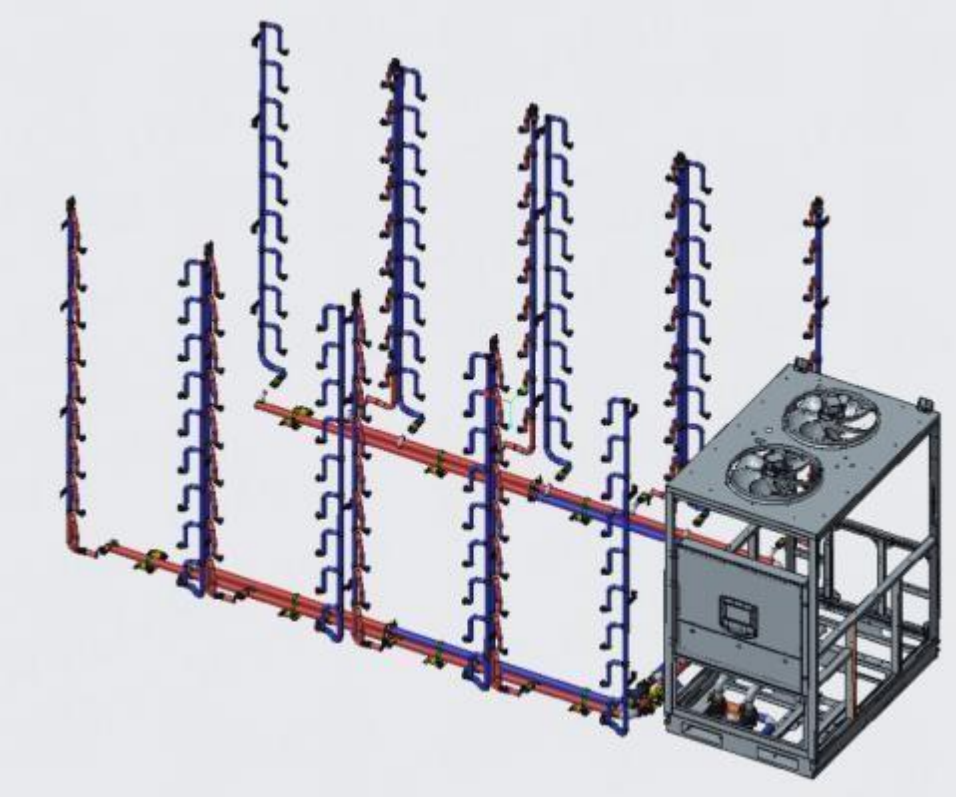
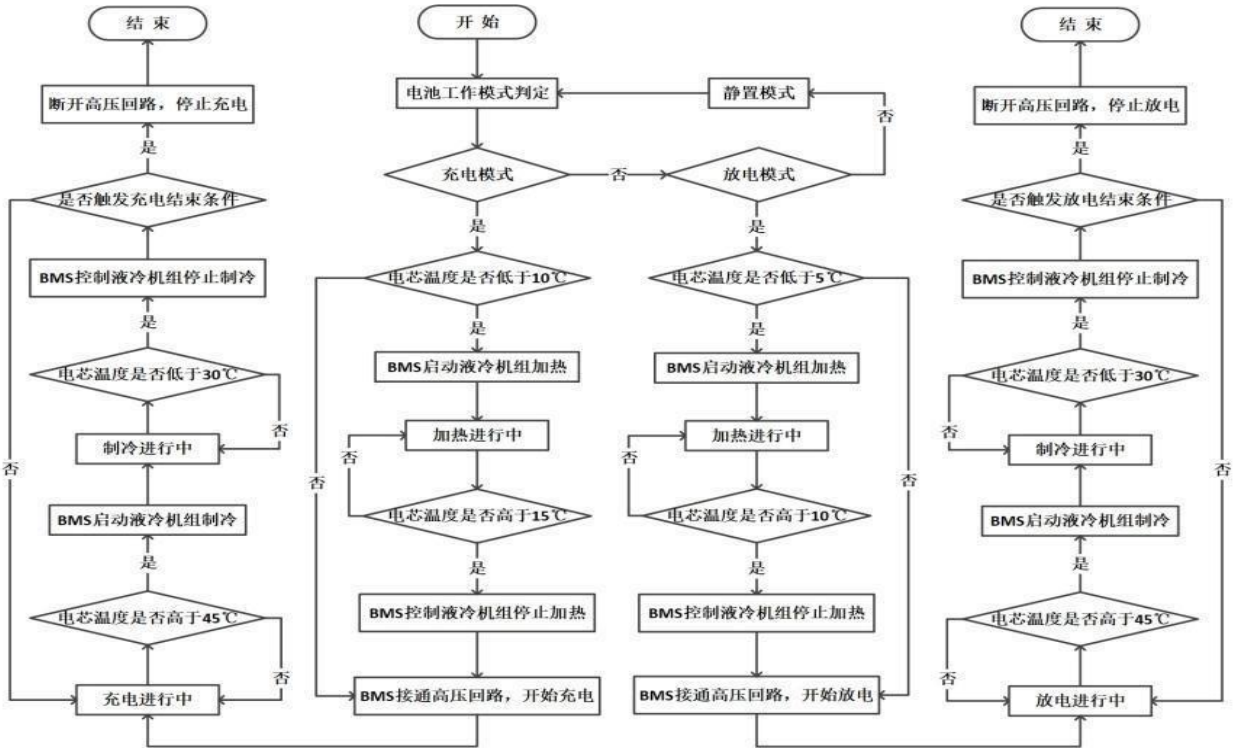


Figure 16 Piping & Unit Schematic Diagram

4.3 liquid cooling strategy

When Tmax≥35℃, the liquid-cooled unit enters the cooling mode, the compressor is turned on, the high-temperature and high-pressure refrigerant is discharged from the compressor, enters the condenser to condense, and after releasing heat and cooling down, it is throttled and reduced by the expansion valve, and then enters the evaporation evaporator, and exchange heat with the cooling liquid, the refrigerant absorbs heat and evaporates in the evaporator, and then flows back to the suction port of the compressor to complete a refrigeration cycle. At this time, the water pump in the water circuit is turned on, and the PTC heater is not turned on. After cooling in the plate evaporator, the coolant enters the liquid cold plate of the battery pack to cool the battery and take out the heat, so as to achieve the purpose of cooling the battery. When Tmax≤25℃, stop cooling mode.
When Tmin≤0℃ (Tmin≤5℃ in charging mode), the liquid cooling unit enters the heating mode, the compressor is turned off, the water pump and the PTC heater are turned on, and the coolant is heated by the PTC heater and enters the battery cold plate. Heat the battery. This mode is suitable for the case where the battery needs to be heated when the battery temperature is too low. When
Tmin≥ 10°C (Tmin≥ 15°C in charging mode), stop the heating mode.



5.Fire fighting method

5. 1 Functional description

The fire extinguishing system abandons the scheme of using heptafluoropropane or perfluorohexanone as the fire extinguishing inhibitor and uses YEC-1 liquid fire extinguishing medium as the fire extinguishing inhibitor to spray directly into the battery box where thermal runaway occurs, so as to realize rapid fire extinguishing and effectively solve the problem of cooling Cooling and resurgence issues.

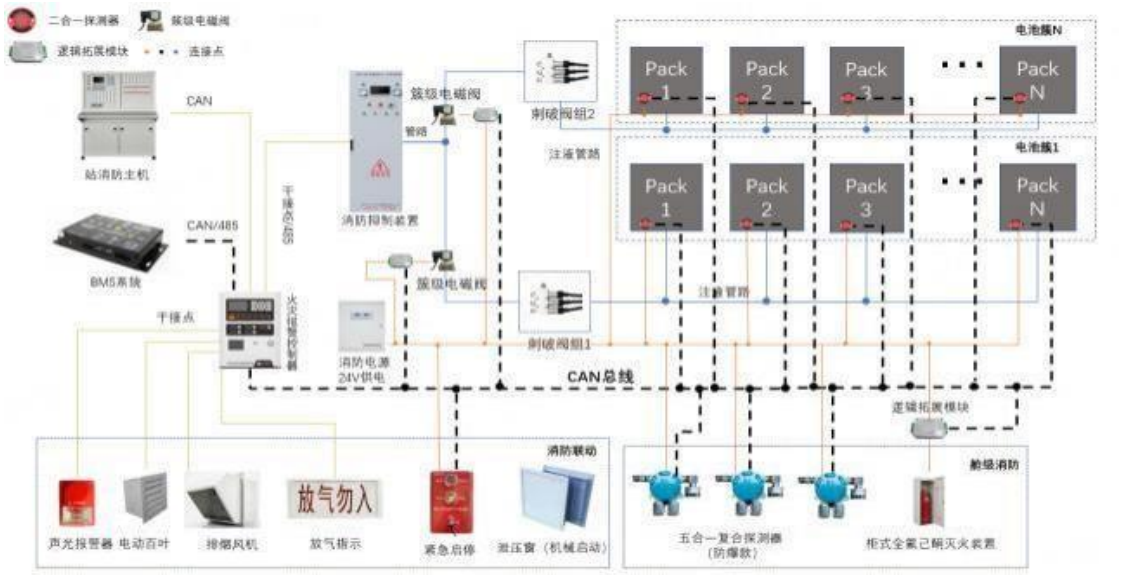

二合一探测器
簇级电磁阀
逻辑拓展模块
连接点
CAN
站消防主机
CAN/485
BMS系统
干接点
消防电源
24V供电
簇级电磁阀
消防控制装置
管路
刺破阀组2
注液管路
电池簇N
Pack 1
Pack 2
Pack 3
Pack N
电池簇1
Pack 1
Pack 2
Pack 3
Pack N
注液管路
刺破阀组1
CAN总线
逻辑拓展模块
消防联动
放气勿入
声光报警器
电动百叶
排烟风机
放气指示
紧急启停
泄压窗（机械启动）
触级消防
五合一复合探测器
（防爆款）
柜式全氟己酮灭火装置

Figure 18 PACK-level fire protection topology

The whole fire fighting system consists of three parts: PACK level fire extinguishing system, cabin level fire extinguishing system and linkage system. The core of the system is: fire alarm control device for energy storage power station (referred to as fire alarm control device), composite fire detection device for hydrogen, carbon monoxide and smoke and temperature sensing (referred to as composite detector) for energy storage power station, electrochemical fire detector The suppression device (referred to as the suppression device), the function is introduced as follows: 1 Fire alarm control device: the information processing center of the entire fire protection system. The main function is to receive and process detectors and other alarm signals internally, issue linkage instructions, and monitor the working status of the entire system; externally communicate with the BMS system, the fire platform in the station and other upper systems, and obtain relevant information about the last system.

1 Composite detectors: divided into PACK-level detectors and cabin-level detectors. The PACK level detector adopts a two-in-one detector of carbon monoxide and smoke, and the cabin level adopts a five-in-one detector with two explosion-proof methods of intrinsically safe and flameproof, which can simultaneously detect carbon monoxide, hydrogen, smoke, temperature,
VOC gas.

1 Suppression device: mainly composed of fire extinguishing medium and pump set
； 5.2 Fire strategy
PACK level fire protection:

Each PACK is placed in the form of a two-in-one detector, and the detection parameters of the detector are carbon monoxide and temperature. The detector switches the electrical connection through the adapter (power supply +, power supply -, CAN_H, CAN_L, puncture valve control), PACK The alarm strategy of the detector is based on the principle of "early detection, timely disposal". The specific trigger conditions and execution actions are shown in the table below.

Pre/alarm level	Triggering condition	Perform action
One level warning	Carbon monoxide concentration > 190ppm	The alarm unit of the controller gives an alarm, and the display and control unit emphatically displays the relevant
		Exceeding parameters; At the same time, the early warning signal is transmitted to the monitoring platform of the fire control room;
Second level warning	Carbon monoxide concentration > 500ppm or temperature > 65℃	The alarm unit of the controller gives an alarm, and the display and control unit emphatically displays the relevant Exceeding parameters; Linkage shunt tripping, turn on the sound and light alarm, and at the same time send the warning signal The number is transmitted to the monitoring platform of the fire control room;
Third level warning	Carbon monoxide concentration > 800ppm and {Temperature > 75℃ or the temperature rise is greater than 3℃/s (For at least 10 seconds) }	The alarm unit of the controller gives an alarm, and the display and control unit emphatically displays the relevant Exceeding parameters; Linkage shunt tripping, turn on the sound and light alarm, and at the same time send the warning signal The number is transmitted to the monitoring platform of the fire control room; Execute PACK fire extinguishing action;

Cabin fire protection:

The cabin level is detected by arranging three explosion-proof 5-in-1 composite detectors on the top of the cabin. The fire-fighting method is perfluorohexanone + water flooding, and the firefighting water source is connected externally. Because the cabin-level fire control is related to the safety of the entire cabin, it is also the last line of defense. Therefore, the alarm strategy of the cabin plan is based on "cabin alarm, automatic fire extinguishing + manual disposal", specific trigger conditions and execution actions.

Pre/alarm level	Triggering condition	Perform action
One level warning	There is a detector in the system to upload a first-level early warning signal. The detector generates a level-1 warning condition: Hydrogen concentration> 150 ppm or Carbon monoxide concentration > 150ppm	The sensor increases the sampling frequency in order to understand the concentration change of the detector in real time ;
Second level warning	There are at least two detectors with different numbers in the system uploaded to the second level warning sign. The detector generates a secondary warning condition: Hydrogen concentration > 200 ppm or Carbon monoxide concentration > 190ppm	The alarm unit of the controller gives an alarm, and the display and control unit emphatically displays the relevant over-standard parameters; the controller turns on the sound and light alarms inside and outside the station, the smoke exhaust fan, and the electric louvers, and at the same time transmits the early warning signal to the monitoring platform in the fire control room tower ;

Third level warning	There are at least two detectors with different numbers in the system uploading to the third level Thermal runaway alarm signal. The detector generates three alarm conditions: smoke alarm and (Hydrogen concentration >500 ppm or Carbon monoxide concentration > 490ppm or VOC > 1000 ppm or temperature greater than 70℃)	The alarm unit of the controller gives an alarm, and the display and control unit displays three-level alarm information; Link BMS to disconnect cluster-level power supply, PCS and shunt trip, turn off air conditioner, smoke exhaust fan, electric louvers, and start sound and light alarm; Execute cabin level perfluorohexanone spraying action； Manually confirm the fire situation, turn on the flood irrigation, and transmit the alarm signal to the monitoring platform of the fire control room at the same time;

6. Dimensions of the battery container

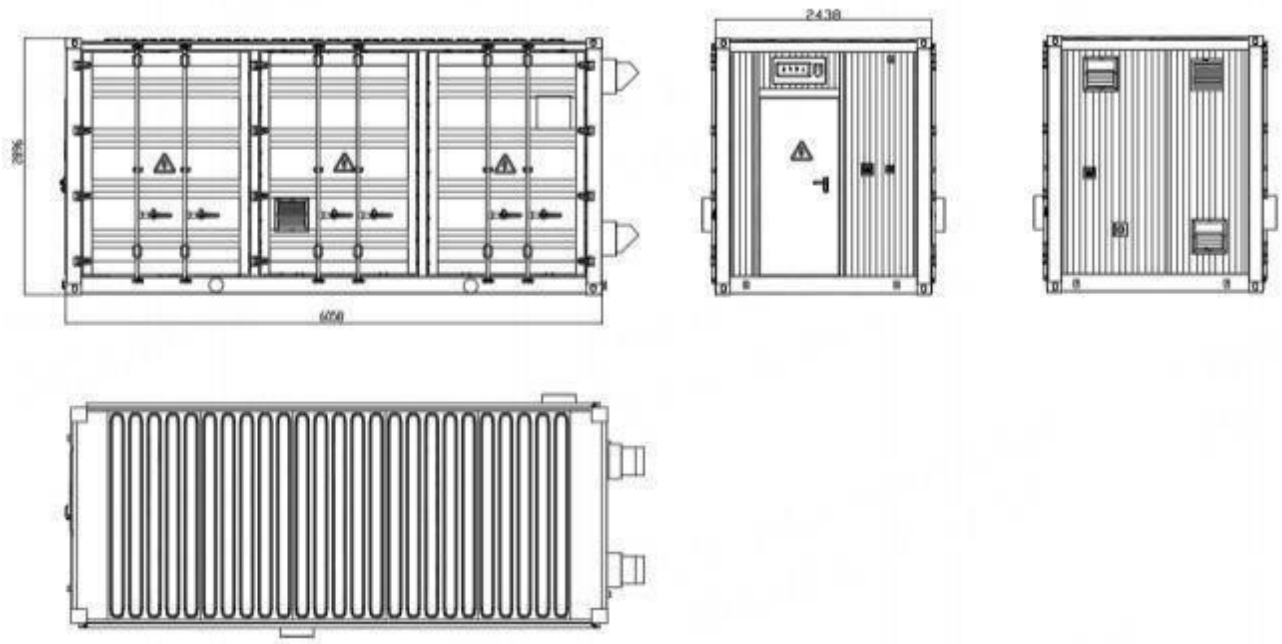


Figure 19 Dimensions of battery container

7. Battery box cluster installation and container hoisting

7. 1 **Install battery boxes in clusters**

The battery pack is pushed out into the container workflow: move the clustering tool with the battery pack to the front of the container and keep an appropriate distance. Adjust the entry position of the battery pack through the remote control switch, install the front-end pallet frame, start the switch to push out the beam, and push the battery pack into the container. After the battery pack is stable, control the remote control switch to withdraw from the beam, and then install the battery pack through the bolts Holes and cell clusters fastened in

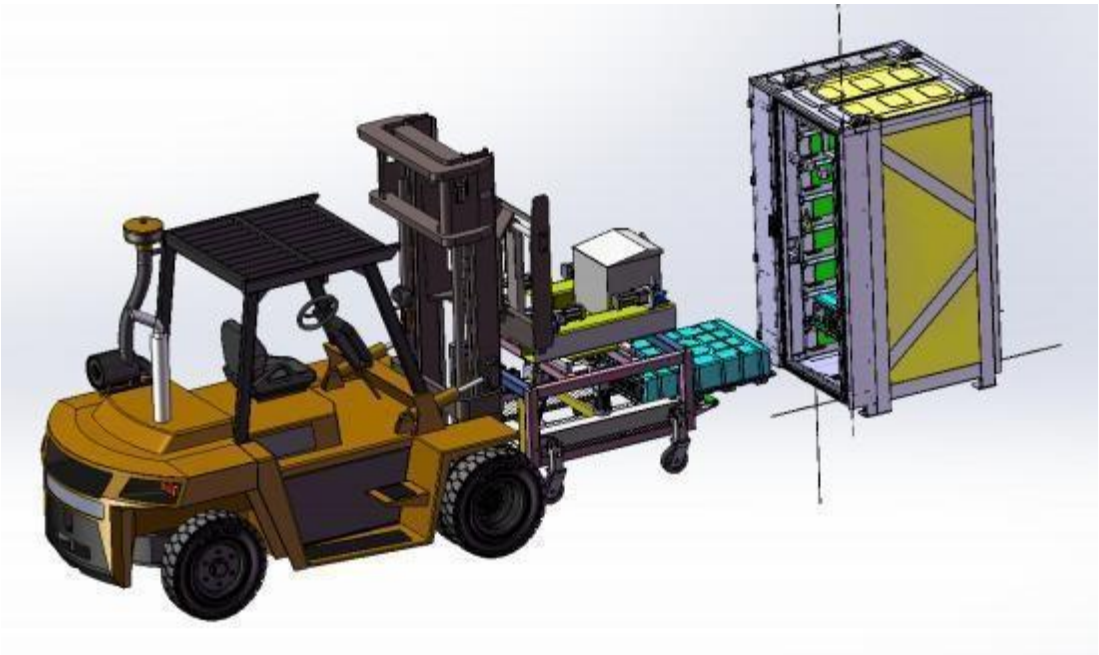


Figure 20 Schematic diagram of installation of battery boxes into clusters

When the battery pack (box) is put in, the box is hoisted to the trundle bed and fixed; then the trundle bed is lifted by a motor forklift . Fork up to the installation position of the container, and position it through the positioning pin on the top of the trundle bed. After positioning, the

stepping motor A drives the trundle bed through the chain sprocket, and transports it to the container body until it is in place;

When the battery pack is pulled out, first assemble the lifting ring to the battery pack (box), and then use a motorized forklift to fork the trundle bed. To the installation position of the container, locate it through the positioning pin on the top of the trundle bed. After positioning, hang the hook on the winch to the lifting ring, and the stepping motor B drives the winch to drive the hook to pull out the battery pack (box). During the pulling process, the stepping motor A Synchronously drive the trundle bed to pull the battery pack (box) until the trundle bed is fixed;

The stepper motor A/B can be driven individually or simultaneously through the button;

7.2 Container Lifting

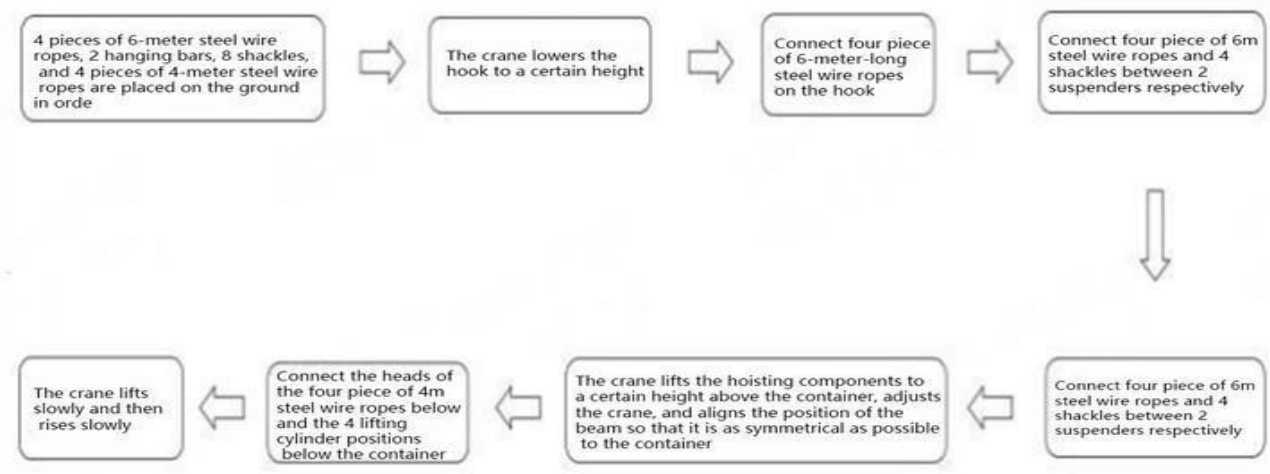


Figure 21 Spreader installation process

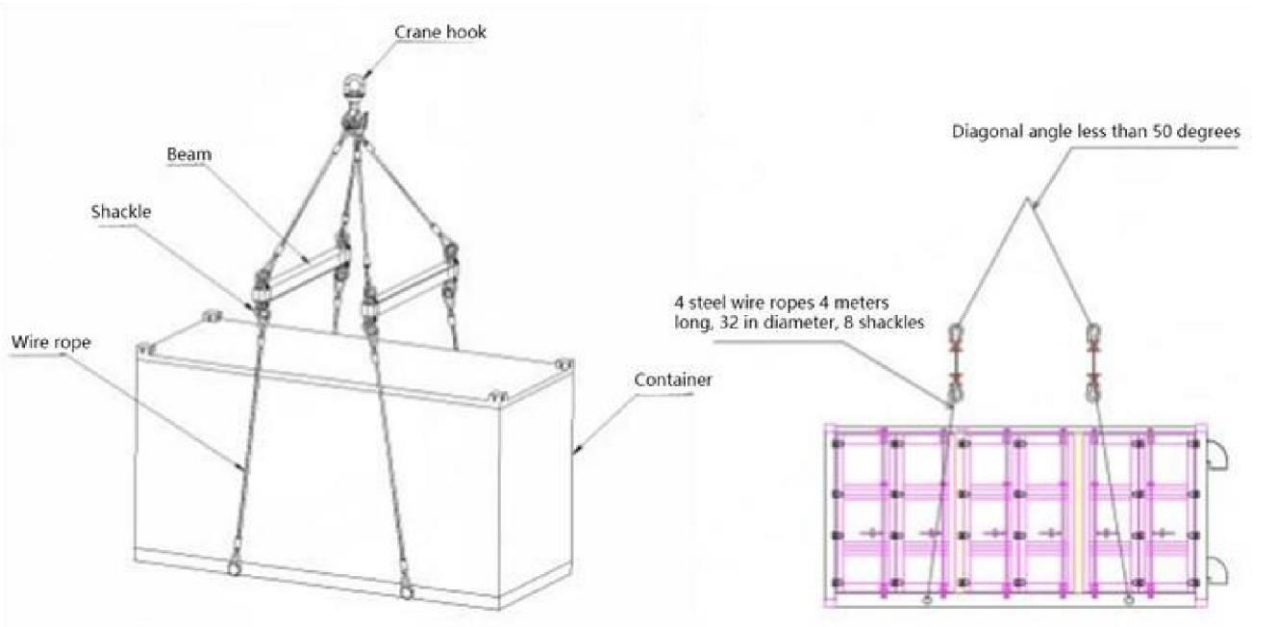


Figure 21 Schematic diagram of container hoisting

The steel wire rope used in this hoisting scheme is D=32mm high-carbon steel wire rope, and the steel core strength is ≥1570Mpa, which meets the relevant requirements of "(GB/T8918-2006) Important Purpose Steel Wire Rope".

The structure is hoisted by a combination of two beams and 4 steel wire ropes, and the centre of gravity of the container is approximately in the middle. Under the condition of safe stress and normal operation, the container hoisting process can be guaranteed to be stable and can work normally.

Table 2 Spreader list

NO	Name	Quantity	Material	Remark
1	Beam	2	20#	I-beam sealing plate load 90T
2	Shackle	8	Alloy steel	60T
3	Wire rope	4	High-carbon steel	Diameter 32 steel wire rope, single load 50T

Statement：

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